

## Radiology Corner

### Cavitary Lung Disease in an HIV-Positive Patient

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*Note: This is the full text version of the radiology corner question published in the March 2008 issue, with the abbreviated answer in the April 2008 issue.*

We present the case of an HIV-positive patient who presents with radiographic and computed tomography findings of cavitary lung disease. There exists a broad differential diagnosis for pulmonary cavitary lesions in immunocompromised individuals. Key factors in narrowing down the differential include clinical setting, CD4 levels, and radiographic findings. Through awareness of the CT appearance of various entities, radiologists aid clinicians in distinguishing between benign and malignant lesions and in some cases obviate the need for transthoracic needle aspiration biopsy.

#### Introduction

Pulmonary cavitation begins with necrosis of the parenchyma. This necrosis is caused by either bacterial toxins and leukocyte enzymes that are present in infection, or as a result of reduced blood supply to the lung tissue secondary to neoplasms. When there is a communication between the parenchymal necrotic material and the bronchial tree, air replaces lung parenchyma, resulting in pulmonary cavitation [1].

There exists a broad differential diagnosis for pulmonary cavitary lesions in immuno-compromised individuals though mostly commonly attributed to an infectious etiology. Computed tomography is a useful tool in assessing the morphological features of cystic and cavitary lesions incompletely evaluated on chest radiographs and may help with the diagnosis.

#### History

A 55-year-old African American female who is HIV-positive presents with nausea, vomiting, and altered mental status. The patient denies fever, chills, night sweats, chest pain, shortness of breath, cough and hemoptysis. Her physical

exam is notable for decreased breath sounds in the right upper lung and a benign cardiovascular exam.

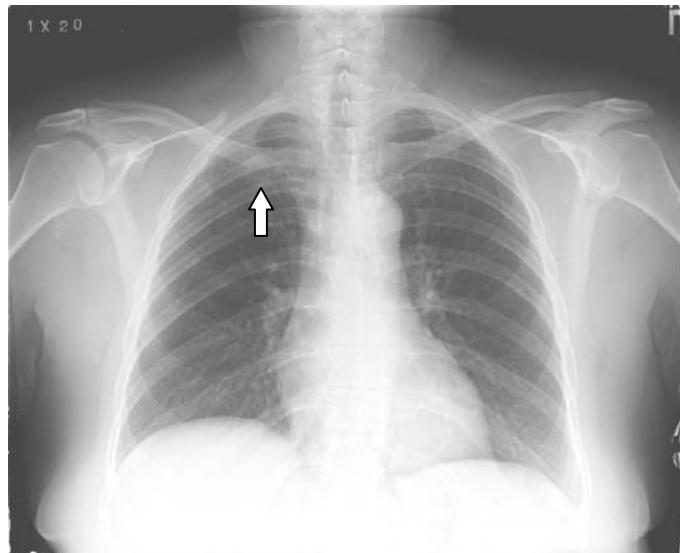


Figure 1(A). Frontal chest radiograph demonstrates a small hazy opacity in the apex of the right lung (arrow).

#### Summary of Imaging Findings

A frontal chest radiograph (Figure 1(A)) demonstrates a small hazy opacity in the apex of the right lung. A frontal chest radiograph of the patient taken two weeks later (Figure 1(B)) reveals a large cavitary lesion with a thick irregular wall measuring 3.8 cm x 4 cm in the apex of the right lung. This lesion corresponds to the small hazy opacity seen two weeks earlier. The remaining areas of the lungs are clear. The cardiomedastinal silhouette is within normal limits and the extrathoracic soft tissue and osseous structures are unremarkable.

An axial CT without contrast of the lungs (Figure 2) demonstrates a thick-walled irregular cavitary lesion in the right lung apex measuring 3.5 cm x 2.7 cm. Multiple primarily subcentimeter peripheral pulmonary nodules are seen on axial CT (Figure 3) scattered throughout the lungs with basilar predominance. There is no pleural effusion or pneumothorax visualized.

#### Diagnosis

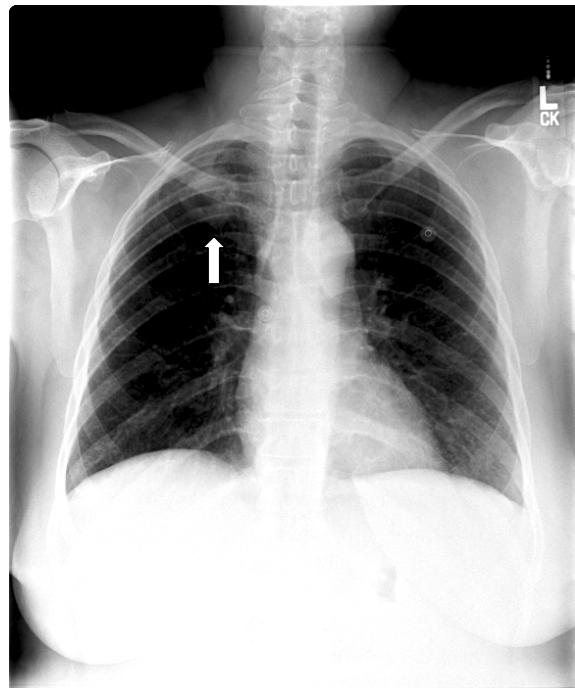
*Aspergillus nidulans*

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**Figure 1(B).** Frontal chest radiograph from the same patient two weeks later demonstrates a large cavitary lesion with a thick irregular wall measuring 3.8 cm x 4 cm in the apex of the right lung (arrow).

## Patient Discussion

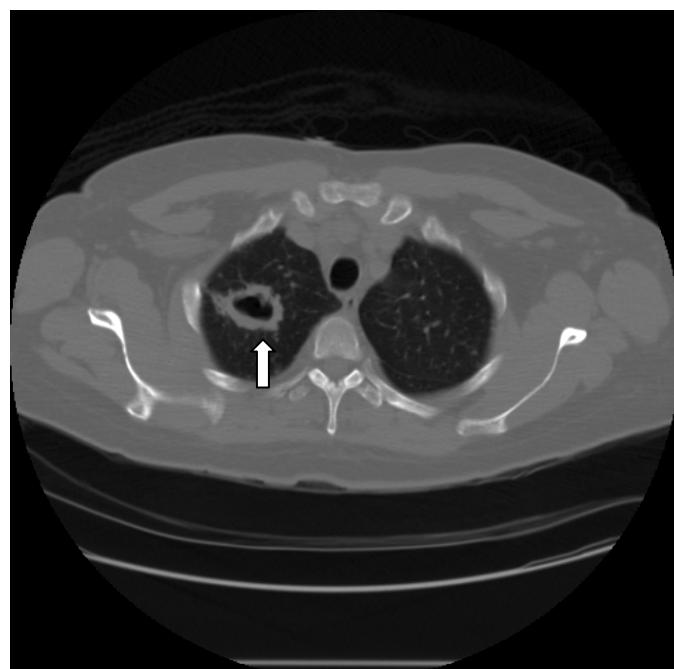
This patient presented with nausea, non-bloody vomiting, and lightheadedness. On admission her CD4 count was 557 cells/mm<sup>3</sup>. A head CT was negative. The above findings were discovered on frontal chest radiograph and chest CT. The patient was ruled out for *Mycobacterium tuberculosis* with three acid-fast bacillus (AFB) smears and cultures. Bronchoalveolar lavage and subsequent respiratory sputum cultures were positive for *Aspergillus nidulans*. Other assays performed ruled out *Pneumocystis jiroveci (carinii)*, *Legionella*, coccidiomycosis, histoplasmosis, *Cryptococcus neoformans*, and *Cytomegalovirus*. She was treated with anidulafungin for aspergillosis.

## Discussion

Pulmonary cavitation begins with necrosis of the parenchyma. This necrosis is caused by either bacterial toxins and leukocyte enzymes that are present in infection, or as a result of reduced blood supply to the lung tissue secondary to neoplasms [1]. When there is a communication between the parenchymal necrotic material and the bronchial tree, air replaces lung parenchyma, resulting in pulmonary cavitation.

The cause of pulmonary cavitory disease carries a broad differential from infectious processes, malignancy and vasculitides (Table 1) [2]. In immunocompromised patients an infectious etiology with either bacterial, parasitic or invasive fungal infections are frequently found [1]. In HIV patients, the CD4 lymphocyte count is an important marker for assessing risk of opportunistic infections and neoplasms. The

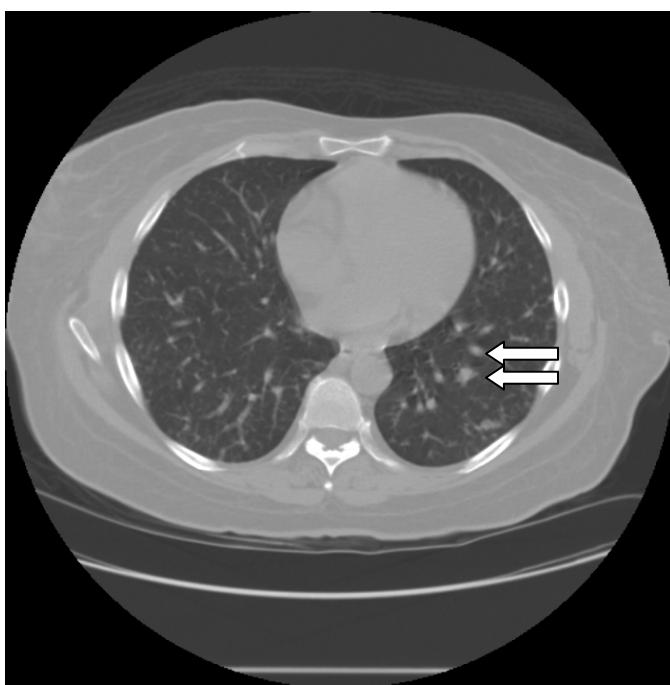
CD4 count is inversely related to the susceptibility of infectious and non-infectious processes. Individuals with a CD4 count over 500 cells/mm<sup>3</sup> are susceptible to infections akin to those of non-HIV/AIDS patients [3]. The risk of bacterial pneumonia increases with decreasing CD4 cell counts [4]. The bacterial cavitory lesions in HIV-positive individuals are mostly polymicrobial; the two most common organisms are *Pseudomonas aeruginosa* and *Staphylococcus aureus* [1] [5]. *Mycobacterium avium complex*, *Candida albicans*, *Pneumocystis jiroveci (carinii)*, and *Cytomegalovirus* rarely cause cavitation by themselves [3]. In HIV/AIDS patients, reactivation of *Mycobacterium tuberculosis* is classically seen as a cavitory lesion in the apex of the lung. However, in patients with advanced AIDS, the lesions are typically nonapical, or absent [6].



**Figure 2.** Axial CT image shows a thick walled irregular cavitary lesion in the right lung apex measuring 3.5 cm x 2.7 cm (arrow).

In this case, the diagnosis was aspergilloma, caused by *Aspergillus nidulans*. Pulmonary aspergilloma are cavitory lesions with a pathognomonic “halo sign” on computed tomography scan, or, more commonly, nodular infiltrates and surrounding “ground-glass” opacities. *Aspergillus* spp. are found worldwide, affecting both immunocompromised and immunocompetent individuals, although the former are at a higher risk. There are various *Aspergillus* species, including *A. fumigatus*(most common), *A. flavus*, *A. niger*, *A. terreus* and *A. nidulans*. Patients may present with chronic cough, hemoptysis, weight loss, or fever. Aspergillomas may respond to prolonged courses of oral itraconazoles. Surgical resection is curative and should be considered if hemoptysis is present [7].

Two common neoplasms seen in patients with HIV or AIDS are Kaposi’s sarcoma and non-Hodgkin’s Lymphoma (NHL). While they can cause pulmonary cavitory lesions, they rarely



**Figure 3.** Multiple predominantly subcentimeter peripheral pulmonary nodules are seen on axial CT (arrows) scattered throughout the lungs greater at the bases. There is no pleural effusion or pneumothorax visualized.

do so [1]. Bronchogenic carcinoma frequently causes cavitation in both the immunocompetent and immunocompromised, with the cavitation occurring at the same rate in both groups. Squamous cell carcinoma causes 80% of cavitating lung neoplasms, with the remaining 20% caused by adeno- and large cell carcinomas. Bronchioalveolar carcinoma only occasionally presents as multiple cavitary nodules, while small cell carcinoma almost never cavitates [6].

With cavitary lesions, differentiating malignancy from abscess or another infectious process is a challenge. Computed tomography allows a more precise assessment and is more accurate than plain films alone. Primary lung abscesses are thought to be more common in immunocompromised hosts. The radiographic findings for lung abscess in both immuno-competent and immunocompromised individuals predominantly involve the upper lobe. Lower lobe or multi-lobular involvement may be increased in the immunocompromised [8]. Malignant lesions are frequently associated with a wall thickness over 4 mm at the thinnest part, speculated or irregular margins (both inner and outer), associated soft tissue mass with or without thoracic wall infiltration, and enlarged lymph nodes. Cavitations seen in NHL are most often multiple, with thickened walls and an upper lobe distribution. Tubercular cavitations may present in variable manners, such as lesions with either thin or thick walls, and with or without air-fluid levels. The presence of fibronodular change, however, in the upper lobes and calcification in a cavitary lesion is more suggestive of pulmonary TB [6].

Fungal infections, such as this patient's aspergillosis, often manifest as single or multiple thick walled cavitary lesions in

<b>Infectious</b>	<b>Bacteria:</b> <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , enteric gram-negative rods, <i>Pasteurella multocida</i> , <i>Burkholderia</i> , <i>Haemophilus influenzae</i> types b and c, <i>Legionella</i> , group A streptococcus, <i>Streptococcus pneumoniae</i> , <i>Nocardia</i> , <i>Rhodococcus</i> , <i>Actinomyces</i> <b>Mycobacteria:</b> Tuberculosis and nontuberculous pathogens <b>Fungi:</b> Including endemic mycoses ( <i>Histoplasma</i> , <i>Coccidioides</i> , <i>Blastomyces</i> ) and opportunistic pathogens ( <i>Aspergillus</i> , <i>Cryptococcus</i> , Zygomycetes, <i>Pneumocystis</i> ) <b>Parasites:</b> <i>Paragonimus westermani</i> , <i>Entamoeba histolytica</i> , <i>Echinococcus</i>
<b>Non Infectious</b>	<b>Neoplasm:</b> Primary lung cancer, metastatic carcinoma, lymphoma Pulmonary infarction due to embolus <b>Vasculitis:</b> Wegner's granulomatosis, rheumatoid lung nodules <b>Airway disease:</b> bullae, blebs, cystic bronchiectasis Sarcoidosis

**Table 1.** The differential diagnosis of a cavitary lesion on chest radiograph [2].

the upper lobe. Fungal infections are also associated with focal alveolar opacities and diffuse infiltration of lung parenchyma [6]. Aspergillomas that form in a pre-existing cavity may lead to an "air crescent sign." The "air-crescent sign" is recognized as a crescent-shaped or circumferential area of radiolucency within a parenchymal consolidation or nodular opacity [9]. *Staphylococcus*, *Klebsiella*, or anaerobic bacteria often lead to thin or thick walled, air filled lesions. These lesions are characteristically unstable with regard to their size, location and appearance, and may expand or recede spontaneously over weeks to months [6].

A simple mnemonic may be helpful in triggering a differential in a pinch. Remembering the word CAVITY can help recall the following list: Cancer/ Congenital (or acquired) bullae, Abscess, Vasculitis, Infection (fungal), TB, and cYst (post-traumatic).

A peripheral lung abscesses may also be difficult to differentiate from an empyema. While abscesses tend to be round in shape and form acute angles with the chest wall, empyemas will likely be lenticular and form excessively obtuse angles along the all. The abscess wall is typically irregular in width and has irregular luminal margins, with the wall of an empyema being most often smooth. This wall helps create the "split pleura" sign. Found in the majority of empyemas, this sign is visualized as thickened, separated

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visceral and parietal pleural surfaces on CT [10]. Another sign that may be helpful is a disparate fluid level between frontal and lateral. For example an abscess usually has an even fluid level on the frontal and lateral, whereas empyemas often have fluid levels of different sizes since not spherical in shape.

The authors present the case of an HIV-positive patient with a cavitory lung lesion found on radiograph. There exists a broad differential diagnosis for pulmonary cavitory lesions in immunocompromised individuals. Key factors in narrowing down the differential include clinical setting, CD4 levels, and radiographic findings. Computed tomography is a useful tool in assessing the morphological features of cystic and cavitory lesions unseen on chest radiographs. Through awareness of the CT appearance of various entities, radiologists aid clinicians in distinguishing between benign and malignant lesions and in some cases obviate the need for transthoracic needle aspiration biopsy.

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